Appendicitis and Pregnancy

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• **In 74,000 obstetrical patients at Los Angeles County Hospital the incidence of acute appendicitis in pregnancy was 0.05 per cent. In a study of 36 cases of clinically diagnosed appendicitis in pregnancy between 1956 and 1960, it was shown that the fetal and maternal morbidity and mortality were decreased when a definite operative procedure was done early. The difficulty in diagnosis is increased by the necessary consideration of pyelonephritis and twisted ovarian cyst. Rupture of the appendix increased hazards to maternal and fetal survival. It was noted also that threatened premature labor may indicate a ruptured appendix. Emergency operation with the use of antibiotics in such cases was effective therapy. The incidence of premature delivery was proportionate to the delay in operating. If operation was performed in less than eight hours after admission to the hospital, there was no maternal or fetal loss. A delay greater than eight hours resulted in a 17 per cent fetal loss in premature delivery and 4 per cent fetal loss of infants at term.**

APPENDICITIS in a pregnant or a postpartum patient is a serious problem. Diagnosis is difficult in these conditions and delay in diagnosis and definitive therapy may have severe consequences for mother and fetus.

Studying the problem is beset with obstacles. True incidence is difficult to determine from hospital records, for in some cases appendicitis may be suspected but the diagnosis not recorded unless the patient is taken to surgery and in others the diagnosis may have been entertained but not recorded because another condition was found at laparotomy. This tends to limit the data on incidence to cases in which a clinical diagnosis of acutely inflamed appendicitis is confirmed at operation.

METHOD AND MATERIAL

In the present study, the clinical charts of all patients at the Los Angeles County General Hospital with diagnosis of pregnancy and appendicitis between 1957 and 1961 were reviewed. During this five-year period, there were approximately 56,000 deliveries and 18,000 nonterm pregnant patients admitted. Within this group, there were 36 cases of clinically diagnosed acute appendicitis, an incidence of 0.05 per cent. Twenty-nine patients were antepartum at the time of diagnosis and seven were within six weeks postpartum. Appendectomy was carried out in 35 of the patients. One patient had ovarian cystectomy only and three others had ovarian cysts removed as well as the appendix. Diagnosis was confirmed by microscopic examination in 21 of the antepartum patients and in six out of the seven postpartum patients. Clinical accuracy in diagnosis was 75 per cent (Table 1).

The age range of the patients was 18 to 40 years, the majority being in their twenties. The parity of these women also was of wide range—zero to 15, the majority being one to four. Two cases occurred in the first trimester, 11 in the second, and 16 in the third.

Since there is much discussion as to the difficulty of making a diagnosis of appendicitis in pregnancy, we analyzed the frequency of the classical signs and symptoms of appendicitis. The chief complaint of the patients was abdominal pain, the pain generally beginning in the upper abdomen and shifting to the right lower quadrant, with associated anorexia, nausea and vomiting (Table 2). Eleven patients, however, did not have shifting pain—only localized pain in the right lower quadrant. Several others emphasized radiation of the pain to the right flank. Less than half the patients were constipated. All patients in this series had right lower quadrant tenderness, although the point of maximum tenderness varied according to the length of gestation. The majority also had rebound tenderness, right-sided tenderness on rectal examination, and decreased bowel sounds. Only eight patients had positive psoas and Rovsing's sign.

During pregnancy, increased leukocyte content that does not go above 12,000 per cu. mm. of blood is not considered indicative of infection.[6] Seven patients in the present series with an inflamed ap-

TABLE 1.—*Incidence of Appendicitis in Pregnancy and the Puerperium, Los Angeles County Hospital, 1957-1961.*

Total obstetrical patients		74,000	
Total with clinical diagnosis of appendicitis*		36	0.05%
Antepartum	29		
Postpartum	7		
Appendectomy performed		35	

*Diagnosis confirmed by pathology in 27 cases—75 per cent.

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TABLE 2.—*Presenting Symptoms and Signs of 29 Pregnant Patients with Clinical Diagnosis of Appendicitis.*

	Diseased Appendix 21 Cases		Normal Appendix 8 Cases	
	Number	Per Cent	Number	Per Cent
1. Abdominal pain shifting to RLQ	12	57%	1	12%
2. Right lower quadrant pain only	8	38%	3	38%
3. Pain in RLQ radiating to flank	2	9%	3	38%
4. Nausea and vomiting	16	76%	6	75%
5. Anorexia	13	62%	5	62%
6. Constipation	7	33%	1	12%
7. Fever	4	19%	1	12%
8. Right lower quadrant tenderness	21	100%	8	100%
9. Rebound tenderness	15	71%	3	38%
10. Rectal tenderness on the right	14	67%	5	62%
11. Decreased bowel sounds	11	52%	3	38%
12. Temperature > 100°	10	48%	2	25%
13. Positive Psoas and Rovsing signs	6	29%	2	25%

pendix had a leukocytosis below that level and 14 patients had a count greater than 12,000 per cu. mm. In two patients with a normal appendix leukocytes numbered fewer than 12,000 per cu. mm. and in six patients it was greater than 12,000. In only one patient, whose appendix was ruptured, did leukocytes exceed 20,000 per cu. mm.

The postpartum patients were consistent only in the complaint of pain in the right lower quadrant of the abdomen, confirmed as tenderness in this area by the examining doctor. The accompanying symptom most commonly present was anorexia. In addition only half of the patients had fever, vomiting, constipation or urinary symptoms. In all cases the differential diagnosis was between acute appendicitis and acute salpingitis. Four patients had definite right adnexal tenderness and three others had a foul cervical discharge, but all of them also had an inflamed appendix. The one patient whose appendix was normal and who had right unilateral acute salpingitis, had no adnexal tenderness, but was exquisitely tender at McBurney's point. She was three days postpartum at the time the symptoms developed. In all but one postpartum patient, the leukocytes numbered more than 12,000 per cu. mm.

TREATMENT

The primary treatment of these patients was surgical. Whenever the diagnosis of acute appendicitis was definitely made on clinical grounds or could not be ruled out as the cause of persistent pain in the right lower quadrant of the abdomen, operation was scheduled as an emergency.

The abdomen was opened through a high right transverse muscle-splitting incision in 31 cases, and through a right paramedian incision in five cases. In all but one case the appendix was removed regardless of its gross appearance. In one instance a right ovarian parasitic dermoid cyst was found and the appendix, which was observed to be normal, was not removed. Although the appendix appeared normal in several cases, microscopic examination showed acute inflammation. In no case was the pregnancy terminated concomitantly by cesarean section.

As a prophylactic measure, ancillary antibiotic therapy—with penicillin and streptomycin or achromycin—was begun preoperatively in all cases of suspected ruptured appendicitis, in all postpartum patients, and in half of the second and third trimester patients. If pronounced suppuration or definite rupture of the appendix was observed at laparotomy, intravenous administration of antibiotics was begun immediately.

Progesterone was used in both of the patients operated upon in the first trimester, in six of eleven in the second trimester and in seven of 16 third trimester patients. Neither of the first trimester patients showed any signs of threatened abortion, nor was there any indication of a relationship between the administration of progesterone and early delivery in the second trimester patients. Of the third trimester patients, those who received progesterone showed a greater tendency to go into premature labor than those who did not receive it. However, progesterone was not thought to be significant in precipitating premature labor.

MATERNAL AND FETAL OUTCOME

The seriousness of appendicitis in pregnancy is reflected in both maternal and fetal outcome, and can be directly related to the rapidity with which the above therapeutic regimen is carried out (Table 3). A period of eight hours was arbitrarily selected as a reasonable time to make the definite diagnosis of appendicitis and get the patient to the operating room. The patients who were operated upon within eight hours after admission to the hospital had few postoperative complications. In patients who went

longer before operation, morbidity, including fever, ileus, urinary tract infection or wound infection was twice as common.

There was one maternal death. The patient, 36 weeks pregnant, entered the hospital after two days of abdominal pain, at first about the umbilicus and later shifting to become localized in the right lower quadrant. Pronounced right lower quadrant tenderness was present. The uterus was irritable, the cervix undilated. Fetal heart tones were strong and regular. Threatened premature labor, silent placenta abruptio and acute appendicitis were considered. Twenty hours after admittance to hospital a diagnosis of ruptured appendix was made and operation was promptly done. Widespread peritonitis had resulted from ruptured suppurative appendicitis. Three days after operation the patient became febrile, uremic and jaundiced and the abdomen was distended. She was delivered of a term stillborn infant on the fourth day and died on the fifth postoperative day. At autopsy, peritonitis, acute tubular necrosis of the kidneys and pronounced fatty changes in the liver were noted.

Both patients whose appendix was removed during the first trimester were delivered of living infants at term. Six of 11 patients operated upon in the second trimester and seven of 16 in the third trimester had premature delivery. Sixty-two per cent of these premature deliveries occurred within the first four postoperative days and thus must be considered to be related to the appendicitis and the operative procedure in the mother.

No patient in whom operation was done within the eight-hour period lost her baby. In the group of patients in whom operation was delayed, four had stillborn infants and one a premature infant who died in the neonatal period. Fetal heart tones had been heard in all patients who later were delivered of a stillborn infant. Thus total fetal loss in patients with delayed operation was 17 per cent. Three of the five infant losses occurred in patients with ruptured appendix.

Postoperative maternal morbidity and fetal loss was greater in patients with a perforated appendix than in the remainder of the group (Table 4).

TABLE 3.—*Relationship Between Delayed Operation, Maternal Morbidity, and Fetal Loss in 29 Antepartum Patients.*

	Less Than 8 Hours Delay	More Than 8 Hours Delay
Maternal morbidity	4	9
Maternal mortality	0	1
Premature delivery:		
Living—Discharged well	3	6
Living—Neonatal death	0	1
Stillborn	0	3
Percentage fetal loss	0	14%
Term delivery:		
Living—Discharged well	8	7
Living—Neonatal death	0	0
Stillborn	0	1
Percentage fetal loss	0	3%

DISCUSSION

A survey of the previous reports on appendicitis in pregnant women shows that most observers believe this to be a distinct and serious problem.[7,9,10] This opinion has recently been challenged by Bassett[1] who expressed belief that the disease is not much different in pregnant than in nonpregnant patients.

The incidence of 0.05 per cent in the present study is somewhat lower than that given by other investigators[2,4]—0.1 per cent to 0.17 per cent. Our figure almost certainly would have been higher if all cases of right lower quadrant abdominal pain in which the diagnosis was considered could have been included in this series. The incidence of pregnancy in women with appendicitis is 2 per cent.[2]

Clinical accuracy in diagnosis—with both the obstetrical and surgical staff agreed upon the diagnosis and operative therapy—was 72 per cent in the present series (Table 1). This is higher than the 42 per cent reported by Bryan[3] and 50 per cent by Dickison.[5]

A wide range is also found in the literature when the incidence of appendicitis is related to the stage of gestation. Black[2] noted no difference between one trimester and the next; Burwell[4] found it three times more common in the first than in the third trimester, and Dickison[5] reported 70 to 80 per cent in the first six months. The majority of the patients in the present series were in the third trimester.

Most patients with appendicitis—especially in the first six months of pregnancy—present the classical findings of abdominal pain shifting to the right lower quadrant, accompanied by anorexia, nausea and frequently vomiting and constipation. Even though, later in pregnancy, the point of maximum tenderness shifts upward and lateral from McBurney's point, there is still definite right lower quadrant tenderness. Rebound tenderness and rectal tenderness high on the right side are additional diagnostic signs present in well over half the cases.

Leukocytes may number as many as 12,000 per cu. mm. in normal pregnancy.[6] Twice as many of the patients in the present series had counts greater than 12,000 as had counts less than 12,000. In cases in which leukocyte count was done more than once before operation there was a moderate rise between the earlier and the later. This increasing count is considered by some investigators[8] to be the only reliable laboratory aid. A leukocyte count greater than 20,000 does not necessarily indicate peritonitis.

TABLE 4.—*Outcome of 5 Cases of Perforated Appendix.*

	Weeks Gestation	Diagnosis/Labor Abruptio	Surgical Delay	Maternal Morbidity	Maternal Mortality	Delivery
Case 1	38	+	7 hours	0	0	Term 3 hours postoperative Living child
Case 2	36	+	56 hours	0	0	Premature 2 hours postoperative Living child
Case 3	36	+	22 hours	+	+	Term 4 days postoperative Stillborn
Case 4	22	0	13 hours	+	0	Premature 2 days postoperative Neonatal death
Case 5	25	+	20 hours	+	0	Premature 2 hours postoperative Stillborn

Nor is the converse true: In only one case of five did the leukocyte content exceed 20,000 per cu. mm. of blood in patients with a ruptured appendix.

DIFFERENTIAL DIAGNOSIS

The differential diagnoses to be considered in antepartum cases are primarily pyelonephritis, twisted ovarian cyst and the round ligament syndrome. Especially in the second and third trimesters, the most difficult distinction is between appendicitis and pyelonephritis. Appendicitis was considered in all cases. Pyelonephritis was considered in 16 of 36. In pregnancy the enlargement of the uterus displaces the appendix upward and laterally,[2] thus shifting the pain of appendicitis to a higher point. This causes frequent discomfort in the right flank and radiation to the right costovertebral angle area. It is this finding of right flank and back tenderness with a few white blood cells in the catheterized urine specimen that leads to confusion. The significance of a small number of white cells in repeated analyses of the urine is difficult to evaluate. This finding may be due to local reaction around the ureter from a retrocecal appendix; or there may be no abnormalities in the urine in the presence of pyelonephritis with right ureteral obstruction and hydronephrosis. An intravenous pyelogram may be necessary to make the distinction.

Twisted ovarian cysts may also rise out of the pelvis with advanced pregnancy, but they should be readily palpable. Cysts lying out of the true pelvis will produce pain high in the right lower quadrant of the abdomen. Even though in none of our cases was there a right lower quadrant mass palpable, this diagnosis was considered in 40 per cent of the cases. Small subserous fibroids may become infarcted during pregnancy and become painful, but are usually palpably connected to the uterus.

The possibility of round ligament syndrome was mentioned in four cases. The stretching of the round ligament and the enlarging of broad ligament varices may cause significant pain in the right lower quadrant of the abdomen, especially in the presence of dextrorotation of the uterus. However, pain on this basis has no accompanying gastrointestinal symptoms and is usually readily relieved by rest and position change.

If one is considering the possibility of acute appendicitis in a woman in the third trimester, and on examination of the abdomen he feels an irritable uterus, suggesting threatened premature labor, the appendix may have already ruptured. Generalized tenderness is not always present in these circumstances. Threatened premature labor or abruptio placenta was considered in four of five patients with a ruptured appendix in the present series. Due to the large contractile mass of the uterus, infection is not manifest as a localized abscess and peritoneal irritation from the wider inflammatory reaction may be the initiating factor in premature labor.[2]

In the first trimester, the possibility of ectopic pregnancy must be considered. Although the uterus may be enlarged, an adnexal mass and tenderness are present in ectopic gestation. In one of the cases in the present series the patient was put in hospital the week before laparotomy for observation because of pain in the right lower quadrant of the abdomen and was discharged with the diagnosis of possible unruptured ectopic pregnancy. At operation a ruptured right ovarian cyst was seen and the appendix was normal. As uterine enlargement in this case had not displaced the appendix, the tenderness was at McBurney's point.

In the postpartum period, diagnostic consideration has to be given to the possibility of salpingitis. A past history of pelvic infection and the presence of foul-smelling heavy vaginal discharge as well as true adnexal tenderness are helpful points in distinguishing this disease from appendicitis. After-

birth pain, noted as a factor in some cases by Burwell and Brooks,[4] was not a consideration in any of the cases in the present series.

Prompt operation is the key to successful therapy. One cause of delay is that the patient may be slow to seek medical attention, attributing the pain to the general discomfort of pregnancy. Also, the physician may hesitate to operate during pregnancy, fearing abortion or premature delivery. In this regard it must be borne in mind that surgical operation has been shown to have no effect, *per se*, on gestation.[6]

The present study seemed to indicate an eight-hour limit in which to make a definitive diagnosis and carry out operation. If a definitive diagnosis and decision for operation was not made within this eight-hour limit, the tendency in most cases was to extend the delay to 24 or more, which was dangerous to mother and fetus. Hence successful treatment of appendicitis in pregnant women requires prompt diagnosis and immediate surgery for maximum maternal and fetal survival.

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REFERENCES

1. Bassett, J. W.: Appendicitis in pregnancy, Amer. J. Obstet. Gynec., 82:828-832, Oct. 1961.

2. Black, W. P.: Acute appendicitis in pregnancy, Brit. Med. J., 1:1938-1941, June 1960.

3. Bryan, W. M.: Surgical emergencies in pregnancy and in the puerperium, Amer. J. Obstet. Gynec., 70:1204-1213, Dec. 1955.

4. Burwell, J. C., and Brooks, J. B.: Acute appendicitis in pregnancy, Amer. J. Obstet. Gynec., 78:772-775, Oct. 1959.

5. Dickison, J. C.: Acute appendicitis complicating pregnancy, Canad. Med. Assn. J., 74:367-370, March 1956.

6. Eastman, N. J.: Williams Obstetrics, Appleton-Century-Crofts, Inc., N. Y., 1956.

7. Hoffman, E. S., and Suzuki, M.: Acute appendicitis in pregnancy, Amer. J. Obstet. Gynec., 67:1338-1350, June 1954.

8. Priddle, H. D., and Hesseltine, H. C.: Acute appendicitis in the obstetric patient, Amer. J. Obstet. Gynec., 62:150-155, July 1951.

9. Renn, C. A., Douglas, L. P., and Cushman, G. F.: Perforative appendicitis with generalized peritonitis and pregnancy at term, Amer. J. Obstet. Gynec., 62:1343-1346, Dec. 1951.

10. Schelpert, J. W., III: Acute appendicitis in the obstetrical patient, New York J. Med., 61:4032-4035, Dec. 1961.